Towards Articulated Mobility and Efficient Docking for the DuAxel Tethered Robot System

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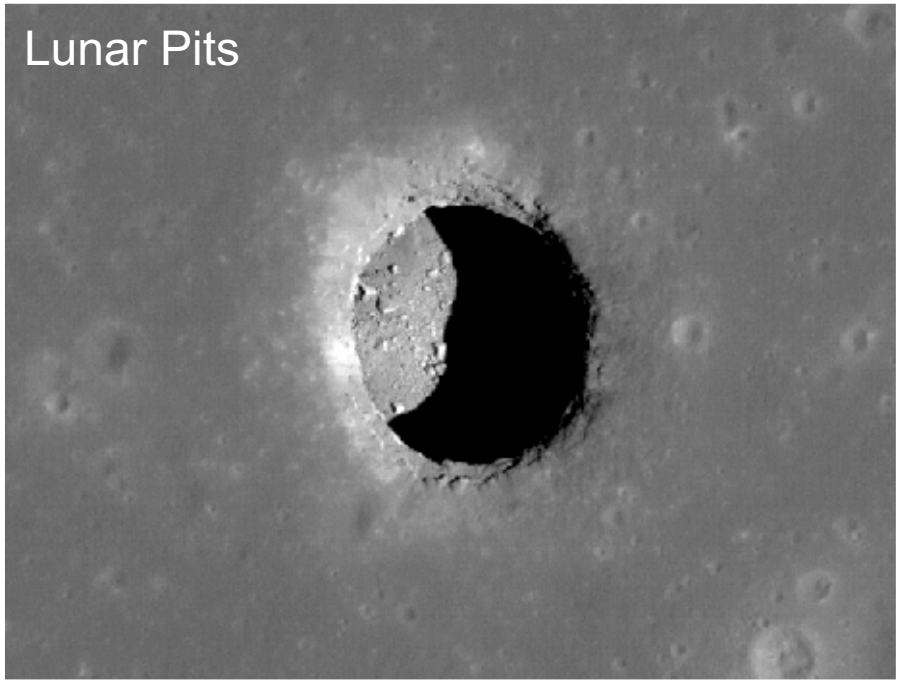
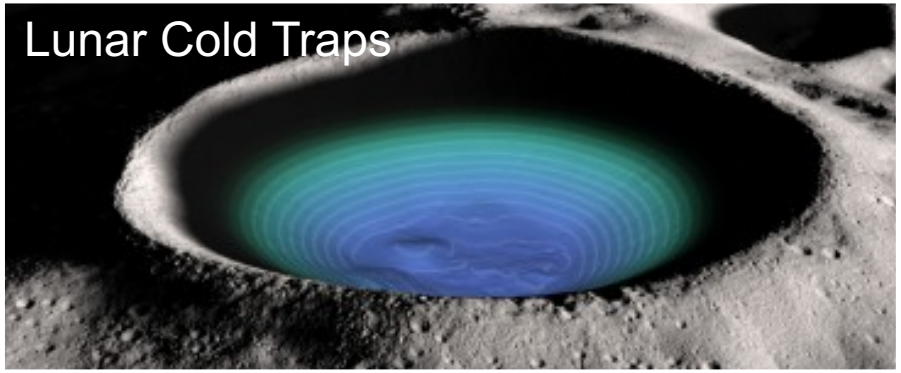
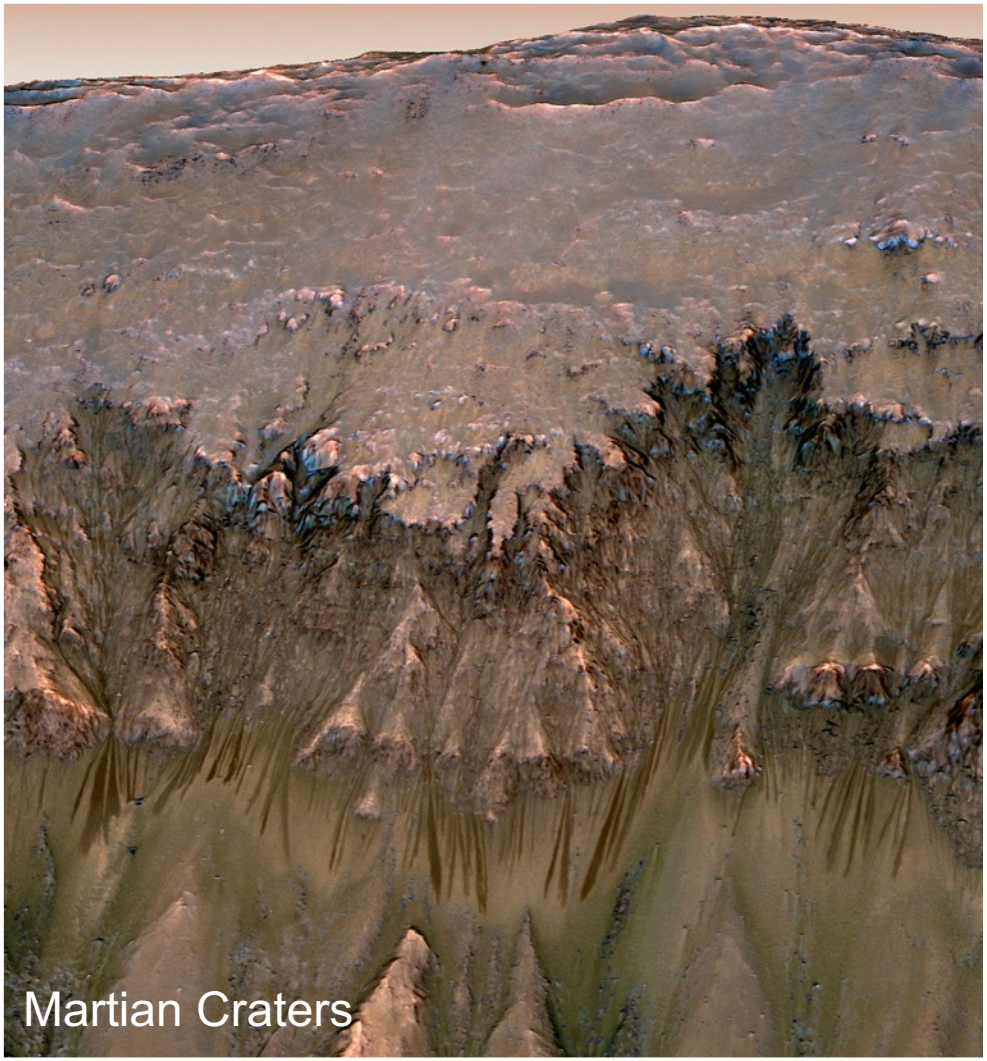
Motivation: Extremely Steep Environments







Motivation: Axel Rovers for Extreme Terrain

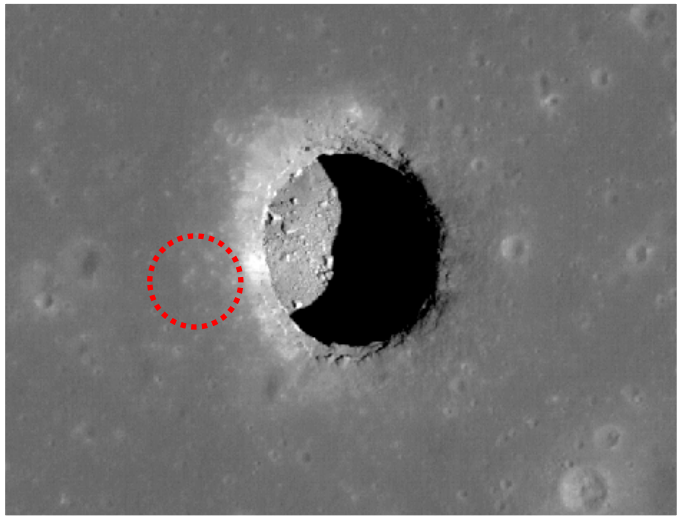
J. Matthews and I.Nesnas, "On the design of the Axel and DuAxel rovers for extreme terrain exploration" (2012)

Challenges: Anchoring

Axel's finite tether length imposes landing site and anchoring constraints

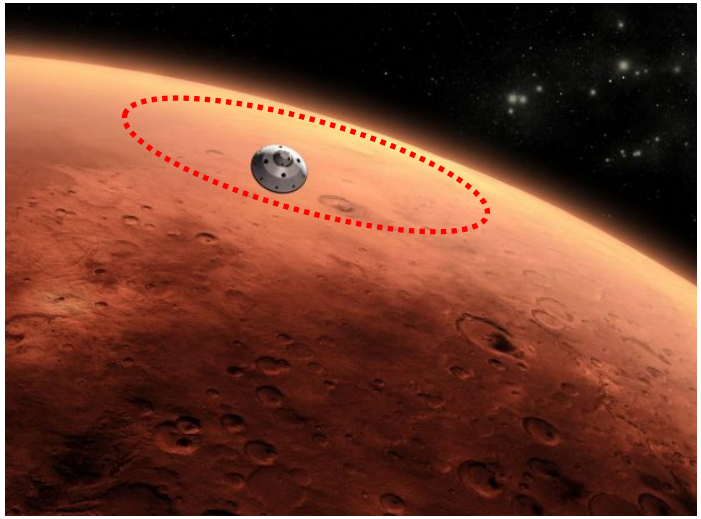
Option 1) Lander as Anchor

- Landing site: ~100m of target
- Anchor: permanent
- Application: the Moon

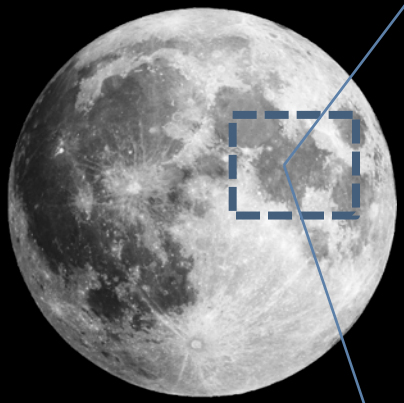


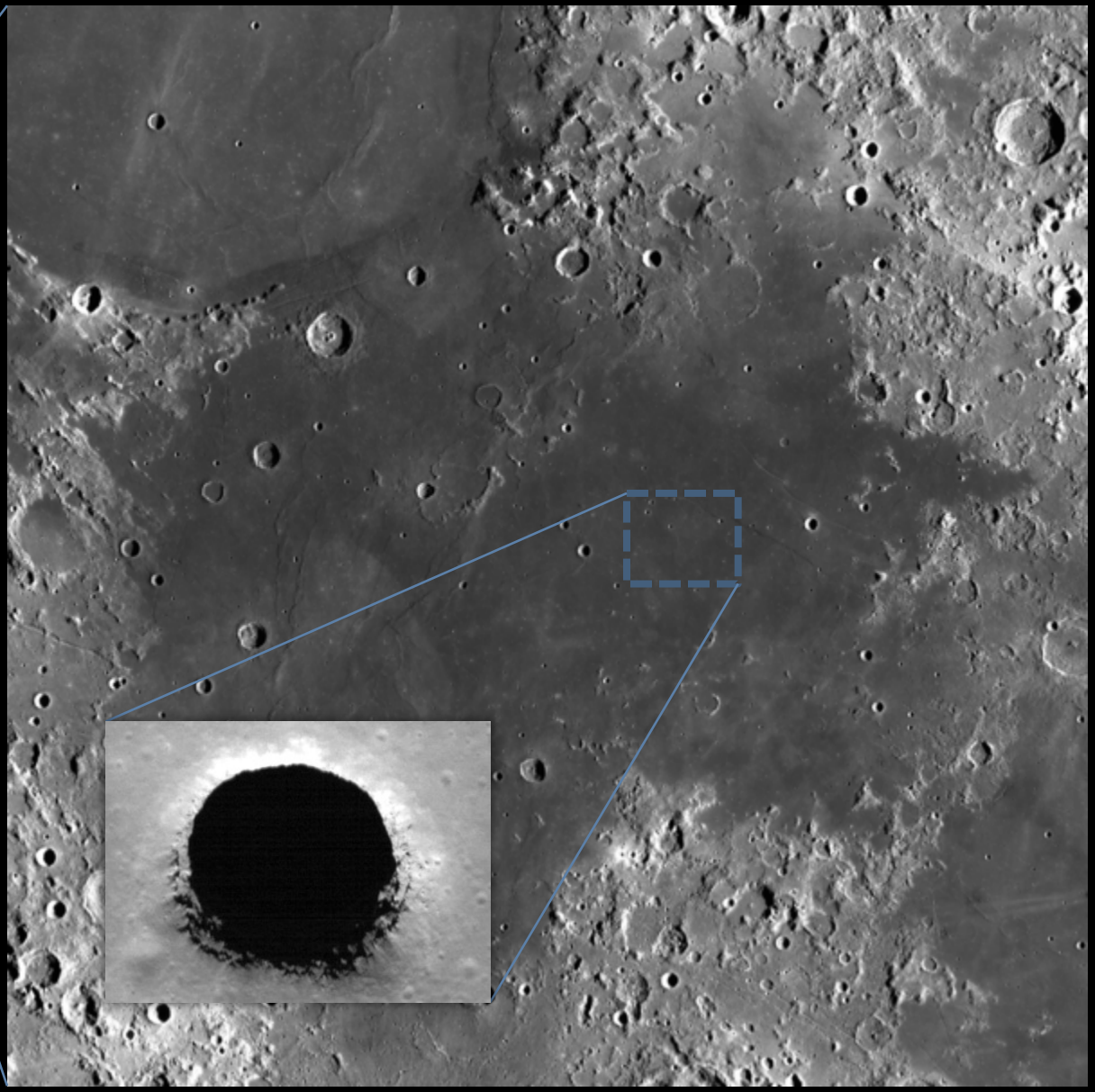
Option 2) Mobile Anchoring

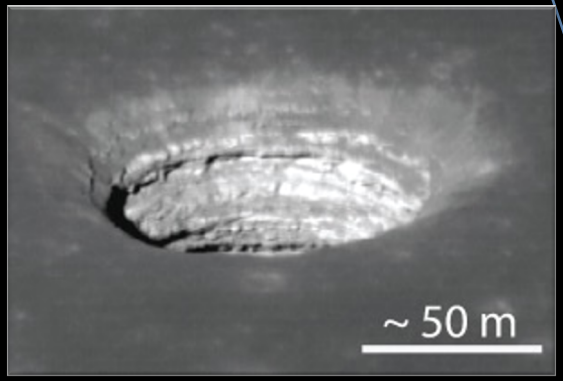
- Landing site: ~kms from target
- Anchor: mobile
- Application: Mars



To the Moon…

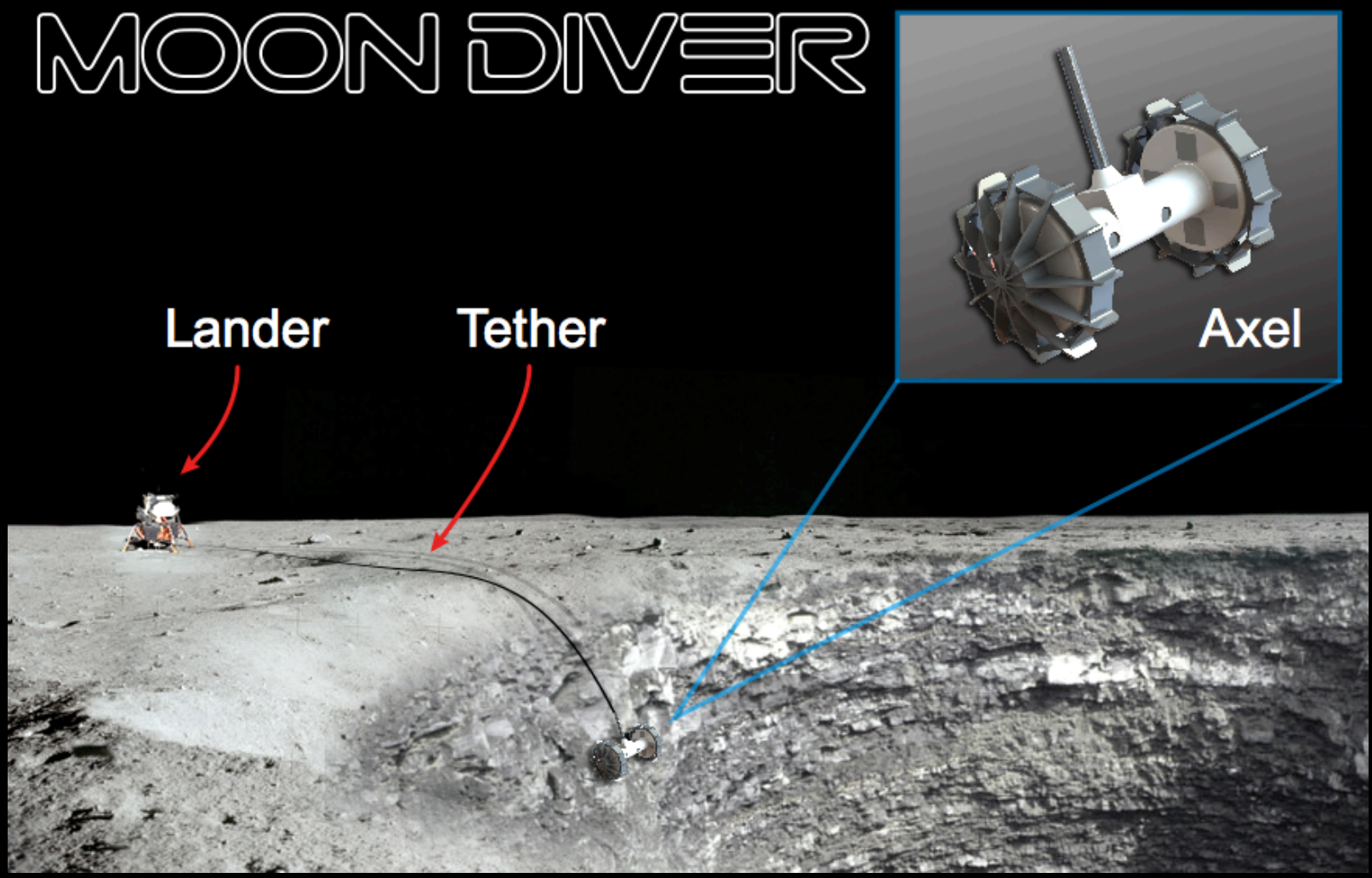






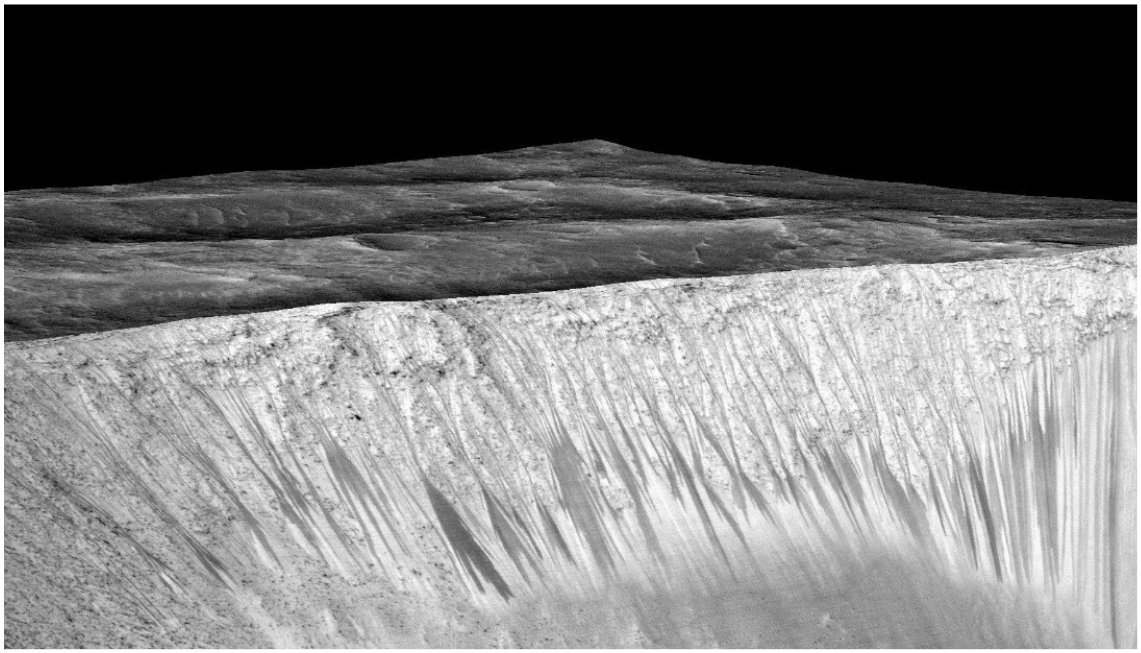
Images: ASU LROC

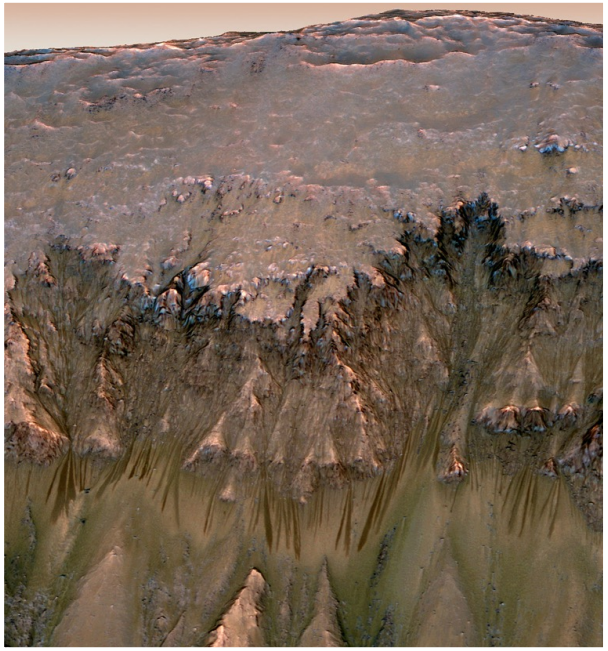
To the Moon…



To the Moon…

To Mars…





- RSL: Recurring Slope Lineae observed seasonally active slope features
- Location: Mars, craters walls, >100m from crater edge
- Instrumentation: Dielectric probe to look for evidence of liquid brines

Related Work: Prior DuAxel System

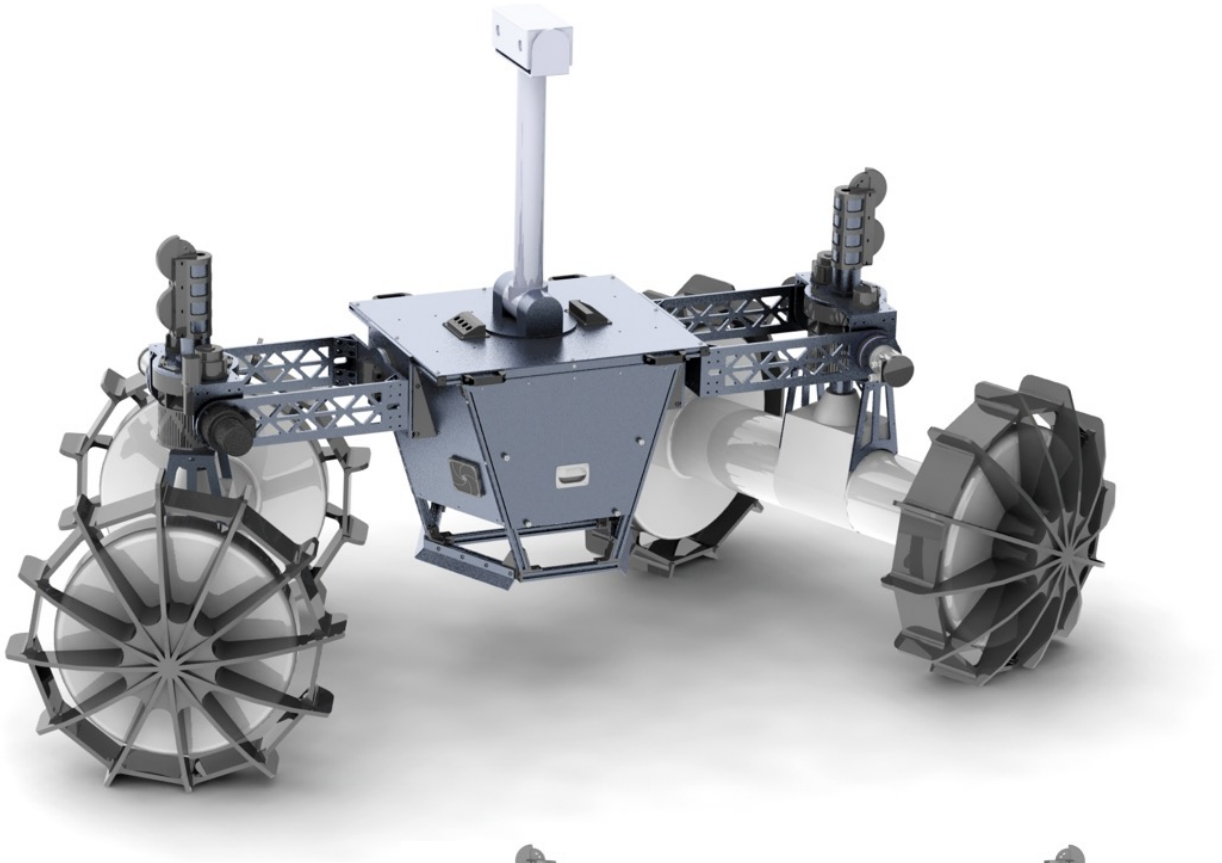
J. Matthews and I.Nesnas, "On the design of the Axel and DuAxel rovers for extreme terrain exploration" (2012)

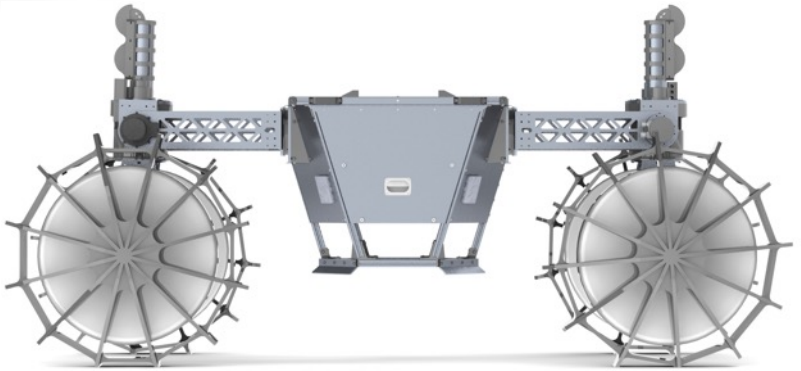
Related Work: Zoë Articulated Mobility

Wagner et al. “Design and Control of a Passively Steered Dual Axle Vehicle” (2005)

DuAxel: Design

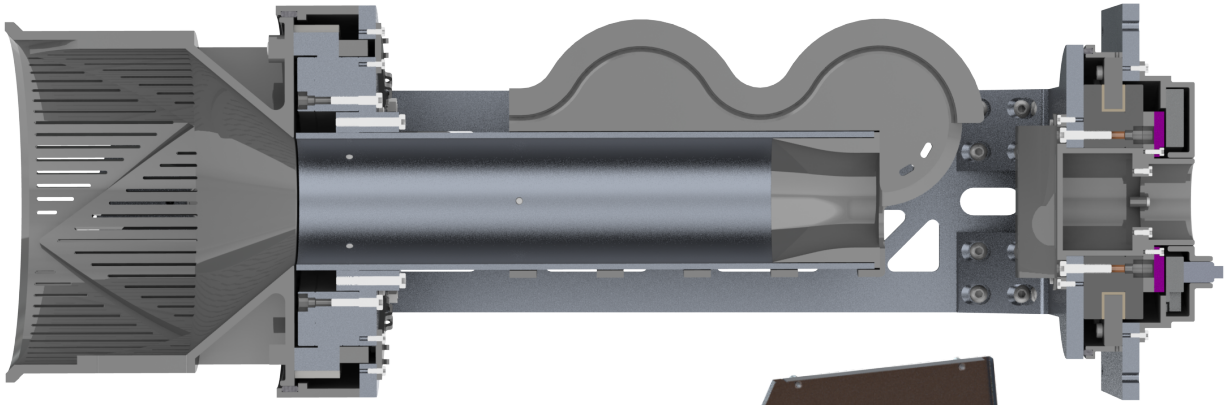
- Articulated Mobility
- Sit/Stand Functionality
- Passive Anchoring
- Redundant Axel

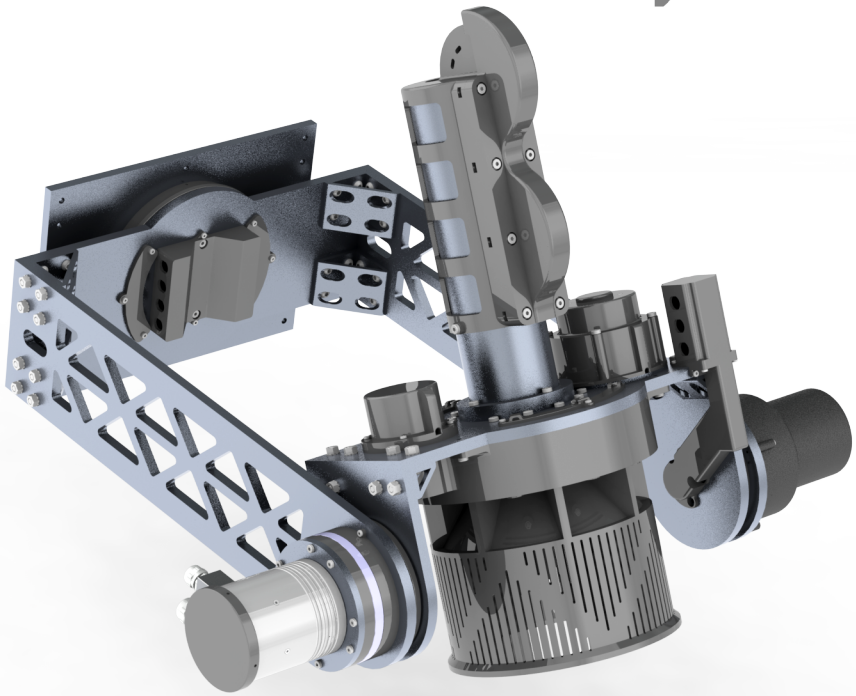




DuAxel: Design

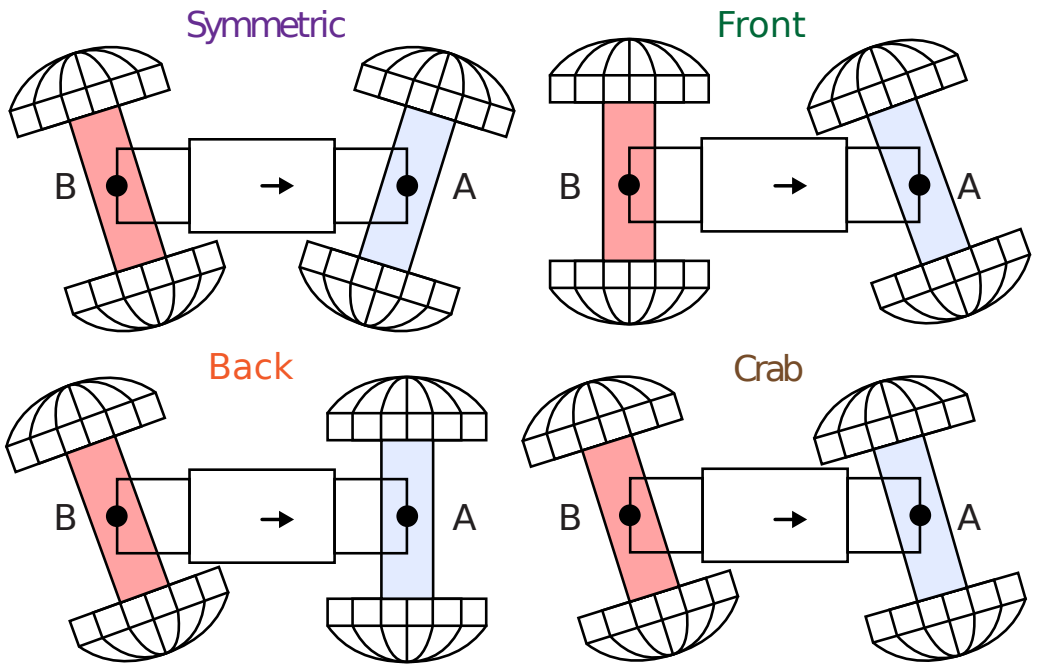
- Docking Mechanism
- Passive Alignment
- Modular Avionics

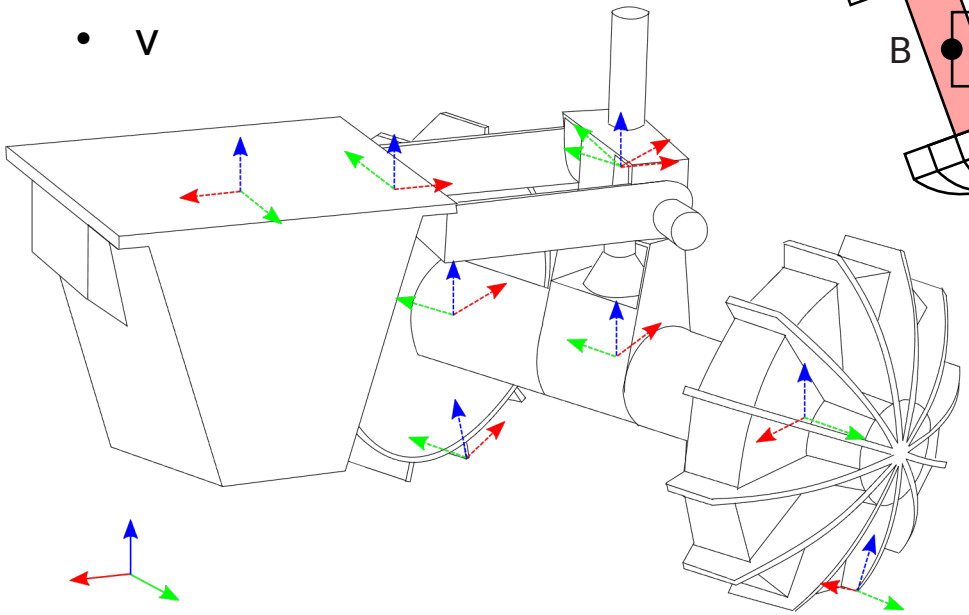




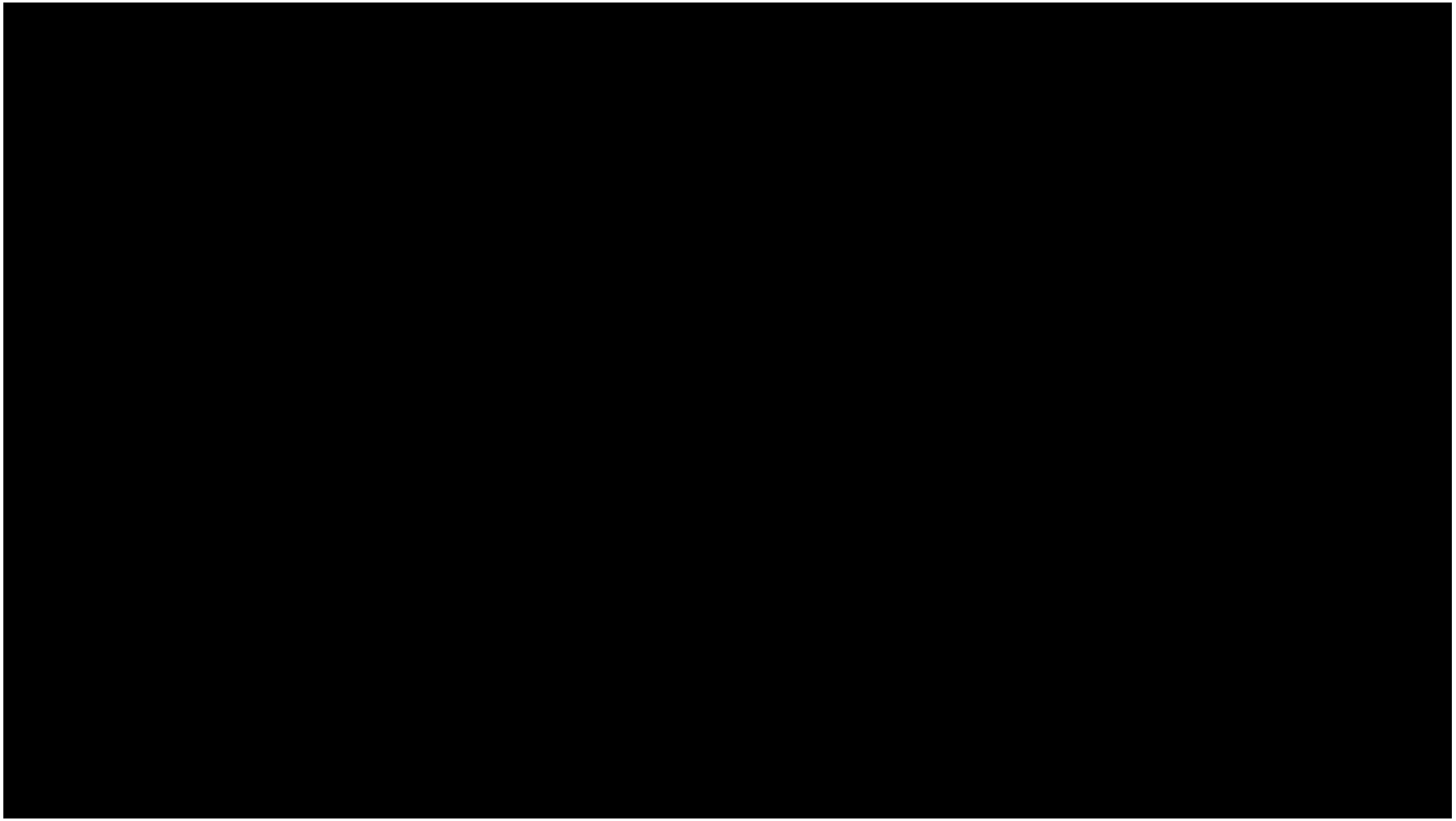
DuAxel: Mobility Modeling

- 4 steering modes
- 8 points of actuation
- 3 robot system
- all joints are passive
- sit/stand joint motor optional
- v





DuAxel: Mobility

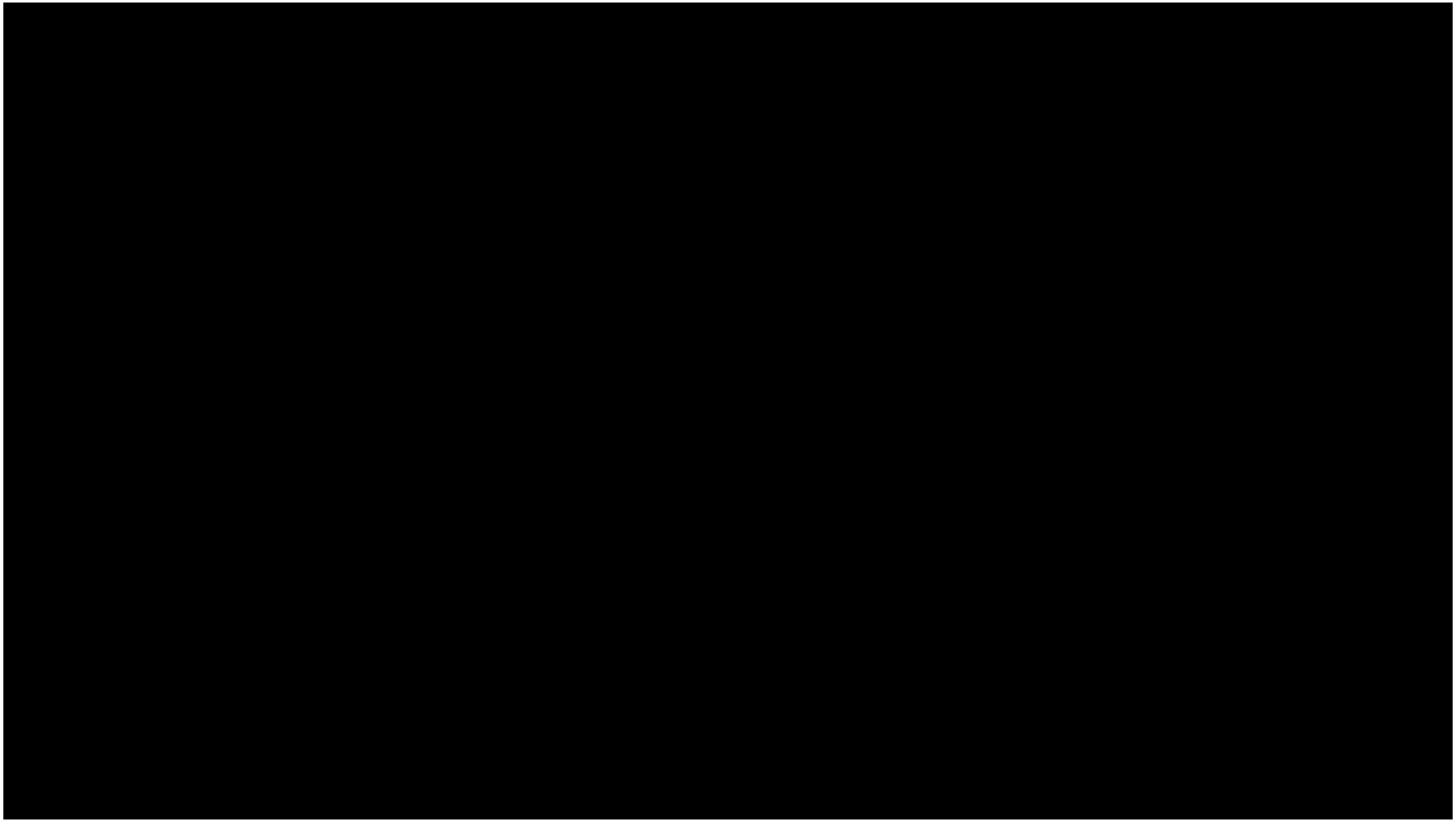


P.McGarey et al., "Towards Articulated Mobility and Efficient Docking for the DuAxel Tethered Robot System " (*IEEE Aerospace*, 2019)

DuAxel: Docking

P.McGarey et al., "Towards Articulated Mobility and Efficient Docking for the DuAxel Tethered Robot System " (*IEEE Aerospace*, 2019)

DuAxel: Sit/Stand



P.McGarey et al., "Towards Articulated Mobility and Efficient Docking for the DuAxel Tethered Robot System " (*IEEE Aerospace*, 2019)

Future Work

- End-to-end sit/stand mobility tests
- Automated docking/undocking
- Visual navigation
- active anchoring for rocky terrain

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